

# Deposition Temperature Mediated Selective Phase Transition Mechanism of VO<sub>2</sub> Films

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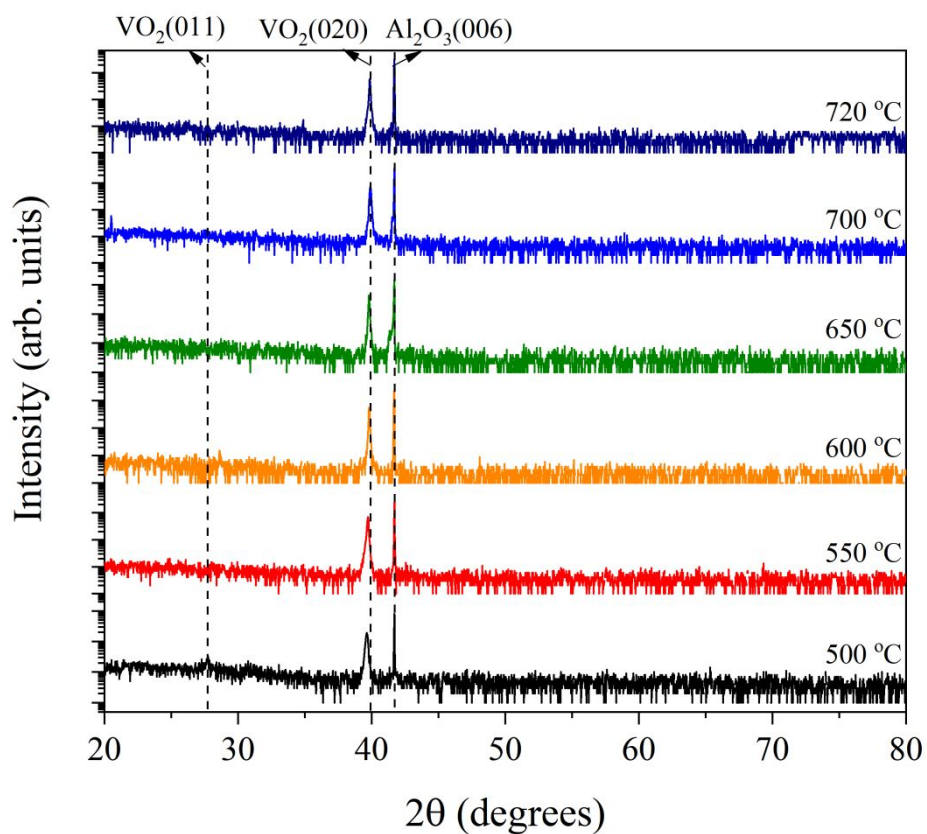
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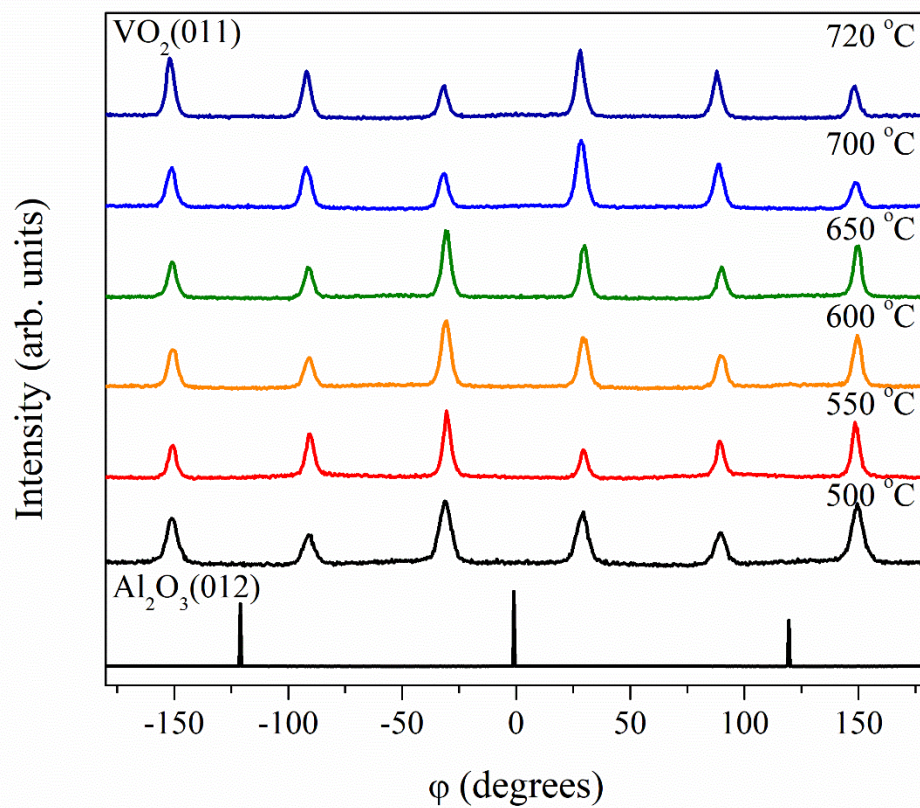
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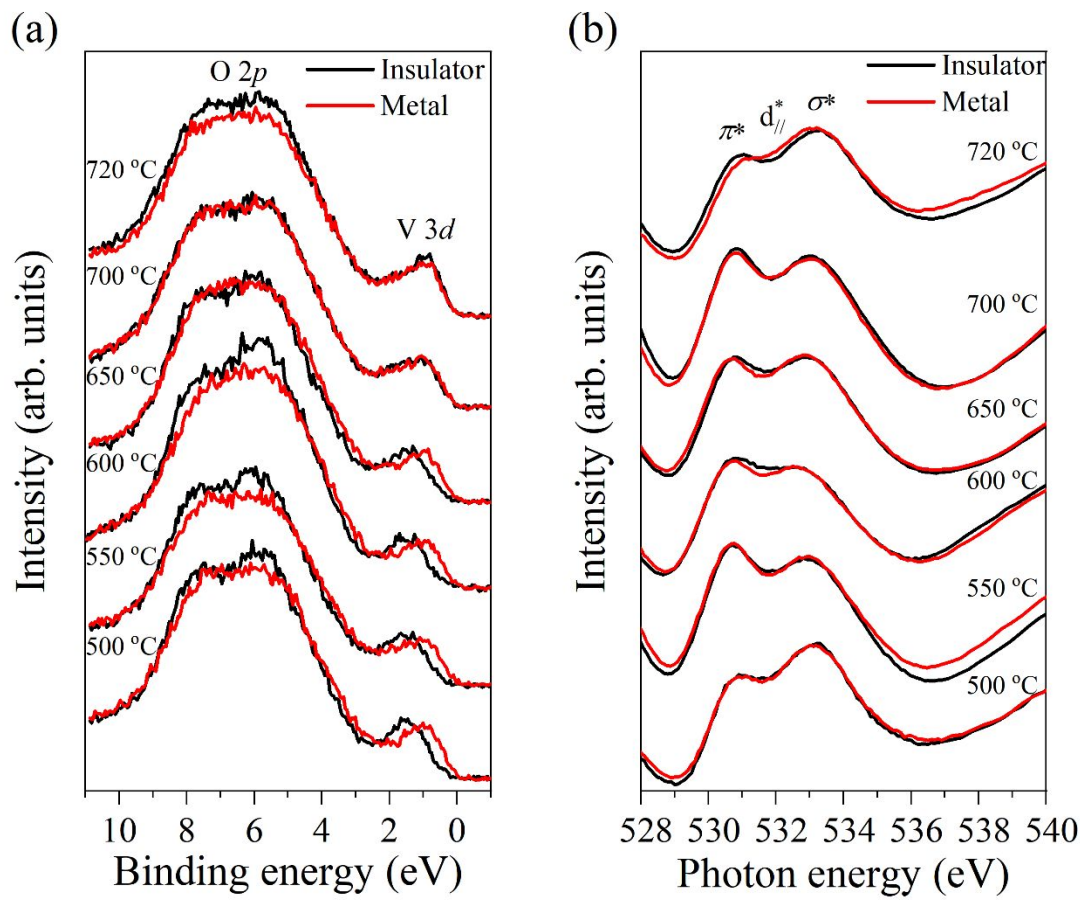
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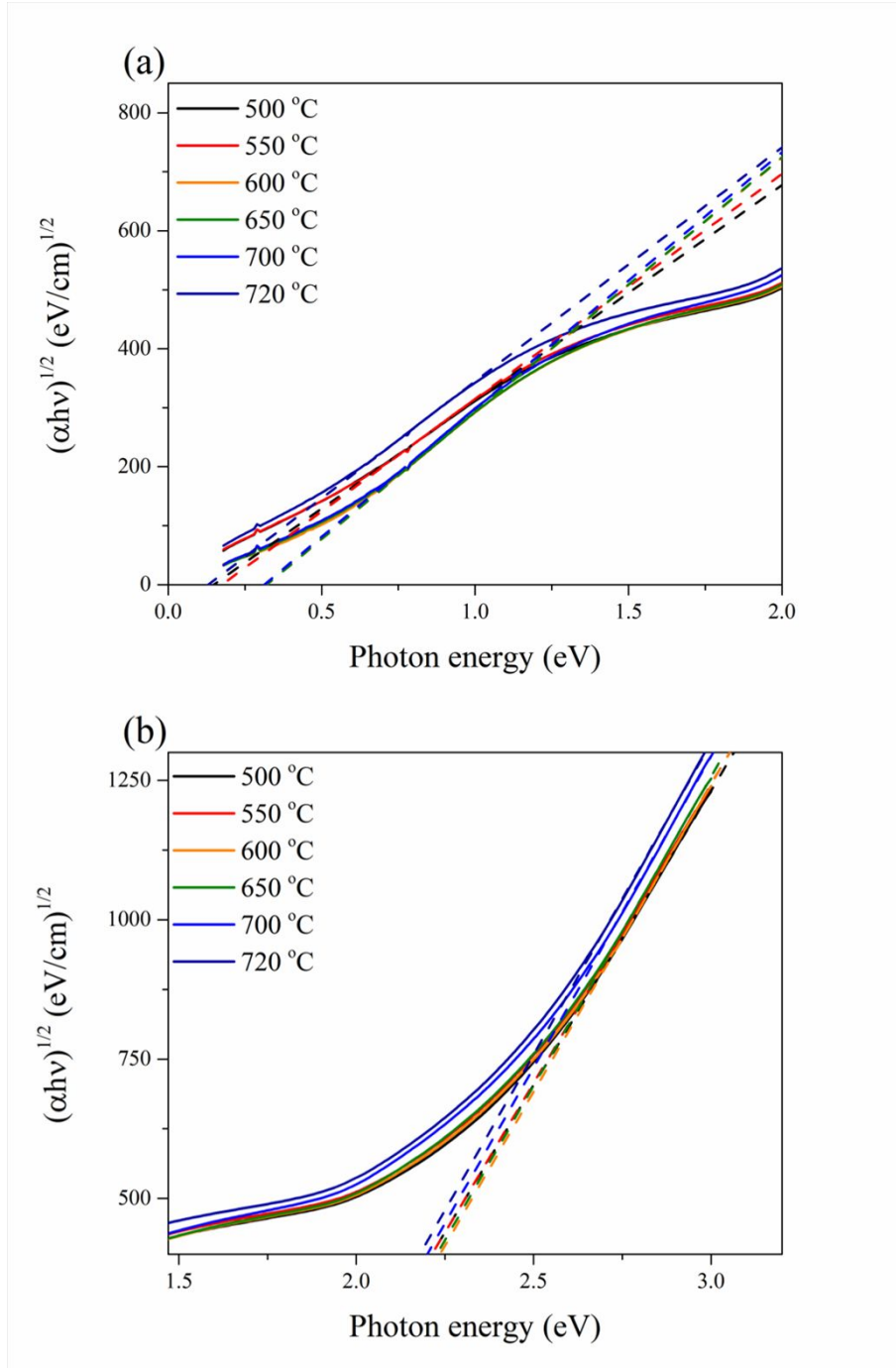
**Figure S1.** XRD  $\omega/2\theta$  full scans of  $\text{VO}_2$  films grown on  $\text{Al}_2\text{O}_3(0001)$  substrates at various deposition temperatures. The vertical dotted lines indicate the reference  $\text{Al}_2\text{O}_3(006)$  ( $2\theta = 41.66^\circ$ ) and bulk monoclinic  $\text{VO}_2(020)$  ( $2\theta = 39.88^\circ$ ).



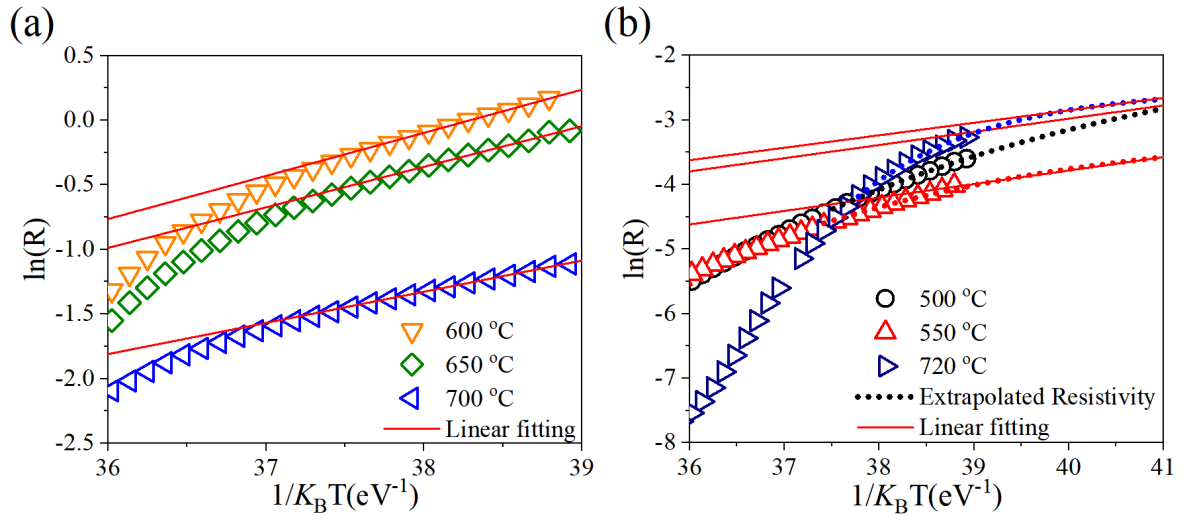
**Figure S2.**  $\phi$ -scans of (011) plane of  $\text{VO}_2$  films grown on  $\text{Al}_2\text{O}_3(0001)$  substrate at various deposition temperatures and the (012) planes of  $\text{Al}_2\text{O}_3(0001)$  substrates.



**Figure S3.** (a) Valence band spectra and (b) O *K*-edge XAS of VO<sub>2</sub> films deposited at 500, 550, 600, 650, 700, and 720 °C for the insulator (measured at RT) and metal (measured at 100 °C) phases.



**Figure S4.** Optical absorption spectra of VO<sub>2</sub> films deposited at various temperatures in (a) low and (b) high photon energy region. Optical band-gap energy  $E_2$  ( $E_1$ ) is obtained from the absorption spectra in the low (high) photon energy region after linear extrapolation. Dashed lines represent the results of the linear fitting.



**Figure S5.** Plot of  $\ln(R)$  vs.  $1/K_B T$  of VO<sub>2</sub> films deposited at (a) 600, 650, and 700 °C and (b) 500, 550, and 720 °C. The solid curves indicate the liner fitted result to obtain the activation energy.

**Table S1.** Binding energy, FWHM and relative peak area ratio of deconvoluted V  $2p_{3/2}$  core-level photoelectron spectra of VO<sub>2</sub> films with various deposition temperatures.

Deposition temperature (°C)	Binding energy (eV)			FWHM (eV)			Relative peak area ratio (%)		
	V <sup>3+</sup>	V <sup>4+</sup>	V <sup>5+</sup>	V <sup>3+</sup>	V <sup>4+</sup>	V <sup>5+</sup>	V <sup>3+</sup>	V <sup>4+</sup>	V <sup>5+</sup>
500	515.20	516.14	517.43	1.50	1.31	1.39	2.54	59.25	38.42
550	515.20	516.16	517.44	1.50	1.37	1.47	2.46	59.25	37.97
600	515.20	516.17	517.47	1.50	1.37	1.45	2.64	61.78	35.57
650	515.19	516.18	517.49	1.50	1.37	1.39	3.98	62.54	34.38
700	515.20	516.17	517.43	1.50	1.23	1.40	6.78	58.22	35.00
720	515.19	516.19	517.47	1.50	1.28	1.42	8.62	57.03	34.35